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## (54) CARPET AND PREPARATION THEREOF

(71) We, THE DOW CHEMICAL COMPANY, a Corporation organised and existing under the laws of the State of Delaware, United States of America, of Midland, County of Midland, State of Michigan, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a carpet and the preparation thereof.

Many carpets are prepared which consist of a low cost backing material such as jute through which filaments are positioned to provide a plurality of tufts extending on one side thereof to form the pile of the carpet. Such carpets are often installed over a resilient backing or an integral resilient backing such as a latex foam is applied thereto. Often, rubber or latex foam resilient backing adhered to the scrim or back of the carpet is of very low strength and oftentimes of minimal resiliency.

The present invention provides a carpet comprising a supporting scrim having extending from one side thereof a pile composed of a plurality of filaments, a resilient backing adhered to the scrim remote from said extending filaments, the resilient backing comprising a plurality of synthetic resinous hollow gas-filled microspheres, the hollow microspheres having a polymer shell, the polymer shell having a glass transition temperature ( $T_g$ ) of at least 50°C, and prefer-

ably a bulk density of 0.25 to 5 pounds per cubic foot (4—80 kg./m.<sup>3</sup>), the microspheres being contained in a synthetic resinous thermoplastic matrix having a glass transition temperature of from -50°C to +20°C. Preferably, the synthetic resinous thermoplastic matrix has a glass transition temperature of from -7°C to +20°C.

Also within the scope of the present invention is a method for the preparation of a backed carpet, the steps of the method comprising applying to the back side of a pile carpet a foam forming composition comprising in intimate admixture an aqueous dispersion containing from about 15 to 85 parts by weight of a film forming synthetic resinous latex binder and from about 85 to about 15 parts by weight of expandable synthetic resinous microspheres, the expandable microspheres having a synthetic resinous thermoplastic shell having symmetrically encapsulated therein as a distinct and separate phase a volatile fluid expanding agent, heating the dispersion to a temperature sufficiently high to remove water therefrom and cause the latex to form a matrix about the expandable microspheres, and heating to a temperature sufficient to cause expansion of the microspheres to form a plurality of gas-filled monoxellular thermoplastic shells.

Preferably, the aqueous dispersion has a viscosity of from 5,000 to 10,000 centipoise.

A wide variety of microspheres may be employed in the practice of the present invention. The particular chemical composition of the microsphere shell and the fluid foaming agent within is not critical. The critical

factor in the microspheres is the glass transition temperature of the polymer forming the shell. Many expandable synthetic resinous microspheres are known and such microspheres and the preparation thereof are described in U.S. Patent 3,615,972. Such microspheres and their preparation are also disclosed in Canadian Patent 752,451 and British Patent 1,044,680. Typical expandable microsphere compositions which are useful are microspheres having a polymer shell of about 60 parts by weight styrene and about 40 parts by weight acrylonitrile containing from about 15 to 20 weight percent isobutane as the volatile fluid foaming agent. Other useful microsphere compositions are methylmethacrylate/acrylonitrile 95:5 parts by weight with neopentane; polymethylmethacrylate with neopentane and polyethylmethacrylate with neopentane.

A wide variety of synthetic resinous latex materials may be employed as the binder or film forming latex in the present invention. The precise chemical composition of the polymer of the latex is not critical. The polymer should be water insoluble and have a glass transition temperature between  $-50^{\circ}\text{C}$  and  $+20^{\circ}\text{C}$ , and should be film forming at a temperature at least  $10^{\circ}\text{C}$  below the temperature at which the expandable microspheres expand, and beneficially, about  $30^{\circ}\text{C}$ . Typical latex polymers which are suitable for the practice of the present invention include latex polymers of, 60 weight percent styrene, 40 weight percent butadiene; 67 weight percent methylmethacrylate, 33 weight percent ethyl acrylate; 85 percent vinylidene chloride, 5 percent ethyl acrylate, 10 percent butyl acrylate; 70 percent polybutadiene, 30 percent acrylonitrile; 80 weight percent vinyl acetate, 20 weight percent diethylmaleate.

Other components may also be incorporated within the aqueous dispersions such as dyes, fillers, pigments, stabilizers for both light and heat, flame retarding agents or other additives commonly employed with aqueous latex dispersions and utilized with benefit.

Dispersions for the practice of the present invention are readily prepared employing conventional latex formulating procedures, as the expandable synthetic resinous microspheres are often available as a wet filter cake containing from about 15 to about 40 weight percent water. No difficulty is encountered in admixing the latex and the microspheres. Generally, for most coating operations, it is desirable to incorporate within the composition a thickening agent such as the thickening or viscosity controlling agents conventionally used with latex coatings, which include a wide variety of water soluble polymers including the sodium salt of polyacrylic acid, hydroxypropyl carbonate,

cellulose, lecithin, and gum agar. As an alternative to thickening the latex, a number of thin coats may be applied, dried, and subsequently foamed. For most applications, it is desirable to provide an aqueous dispersion having a viscosity between about 5 and 10 thousand centipoise. The coating composition may be applied by any conventional coating procedure including spraying, rolling, doctoring, and roll coating. Drying of the coating beneficially may be accomplished prior to foaming, or drying and foaming may be accomplished simultaneously. Such drying and foaming conventionally may be accomplished by circulating heated air, infrared heat, or other heating methods well known to the art. In some instances it is desirable to accomplish the foaming between a pair of parallel belts in order to obtain a product which has a constant thickness. Alternatively, the coating may be prefoamed; that is, foamed without mechanical restriction and passed under a hot doctor roll which may have a temperature of from about  $200$  to  $400^{\circ}\text{C}$  which serves to collapse undesirable protruding portions of the foam backing.

Employing the present invention, a resilient backing is made integral with the carpet with a minimal necessity of process condition control, labor, and materials. The resultant carpets exhibit excellent resiliency and the backings are generally of relatively high strength.

The present invention is further illustrated by the following examples wherein the proportions specified are based on weight.

#### EXAMPLE 1

A coating formulation is prepared by mixing the following ingredients in the order given with gentle agitation at room temperature: 145.8 parts of a latex of 54.9 percent solids (the latex polymers is a copolymer of 60 parts by weight styrene and 40 parts by weight butadiene,  $T_g - 10^{\circ}\text{C}$ ); 27.8 parts water; 2 parts of a 10 weight percent solution of sodium lauryl sulfate; 20 parts of expandable microspheres having a polymer shell of a copolymer of 49 parts styrene and 32 parts acrylonitrile,  $T_g 110^{\circ}\text{C}$ , and containing encapsulated therein 19 weight percent neopentane, based on the weight of the polymer shell; and 12 parts of an aqueous solution of the sodium salt of polyacrylic acid, 11.2 percent solids. The viscosity of the resultant solution is about 7500 centipoise. A 6-inch (15-cm.) square of tufted polypropylene carpet having polypropylene scrim is coated with 20 grams of the foregoing formulation employing a roller. The coating is air dried and subsequently placed between spaced platens in a press. A metal sheet is disposed between the coating and

the press platen, and an asbestos pad is placed between the pile side of the carpet and the other press platen. After 2.5 minutes, the coated samples are removed from the press and have a foamed coating thereon about 0.15 inch (3.8 mm.) thick of expanded microsphere polymer shells having a glass transition temperature of  $>50^{\circ}\text{C}$  and a bulk density within the range of 0.25 to 5 pounds per cubic foot (4-80 kg./m.<sup>3</sup>). The backed carpet is resilient, resists permanent set at ambient temperatures, and is very acceptable for floor covering applications.

#### EXAMPLE 2

A coating formulation is prepared employing 139 parts of the styrene/butadiene latex of Example 1, but with 57.5 percent solids; 34 parts water; 2 parts of a 10 percent aqueous solution of sodium lauryl sulfate; 20 parts of expandable microspheres of Example 1; and 5 parts of the polyacrylic acid solution of Example 1. The weight ratio of latex solids to microspheres is 4:1. The viscosity of the solution is about 8500 centipoise. Twenty grams of the foregoing coating dispersion are applied to a 6-inch (15-cm.) square of polypropylene carpet having polypropylene scrim. The coated carpet is dried in a forced air oven at  $240^{\circ}\text{F}$  ( $115^{\circ}\text{C}$ ) and foamed in a platen press at  $135^{\circ}\text{C}$  as done in Example 1. The resultant sample shows good flexibility, resistance to significant permanent set at ambient temperatures, and resiliency with no tendency for the coating to flake.

#### EXAMPLE 3

A 20-gram portion of the coating formulation of Example 2 is applied to a tufted polyethylene carpet with a polyethylene scrim and dried and foamed in accordance with Example 2. The resultant sample shows good flexibility, resistance to significant permanent set at ambient temperatures, and resiliency with no tendency for the coating to flake.

#### EXAMPLE 4

The procedure of Example 2 is repeated with the exception that a tufted wool carpet having a jute scrim is employed. The backing shows good flexibility, resilience, resistance to permanent set at ambient temperatures, and resistance to flaking.

#### EXAMPLE 5

The procedure of Example 2 is repeated with the exception that a tufted filament nylon carpet with a polypropylene scrim is employed. Similar results are obtained.

#### EXAMPLE 6

The procedure of Example 2 is repeated with the exception that a tufted nylon car-

pet with jute scrim is employed. Similar results are obtained.

#### EXAMPLE 7

The procedure of Example 2 is repeated with the exception that a tufted acrylic carpet is employed having jute scrim. Similar results are obtained.

#### EXAMPLE 8

A coating formulation is prepared employing 170 parts of a latex which is a polymer of 85 percent vinylidene chloride, 10 percent butyl acrylate and 5 percent acrylonitrile Tg  $-30^{\circ}\text{C}$ ; 8 parts water; 2 parts of a 10 percent solution of sodium lauryl sulfate; 15 parts of expandable microspheres of Example 1; and 5 parts of the polyacrylic acid solution employed in Example 1. The weight ratio of latex solids to microspheres is 85:15, and the resultant coating formulation was a viscosity of about 7500 centipoise. A 6-inch (15-cm.) square of tufted nylon carpet having a jute scrim is coated with 20 grams of the formulation and foamed in the manner of Example 2. Similar results are obtained.

#### EXAMPLE 9

A coating formulation is prepared employing the following ingredients: 160 parts of a 50 percent solids latex of a polymer of 40 percent isobutylacrylate and 60 percent vinyl acetate Tg  $9^{\circ}\text{C}$ ; 13 parts water; 2 parts of a 10 percent solution of sodium lauryl sulfate; 20 parts of expandable microspheres having a polymer shell of 80 percent methyl methacrylate, 20 percent methyl acrylate and containing encapsulated therein 33 percent neopentane; and 5 parts of the sodium salt of polyacrylic acid. The weight ratio of latex solids to microspheres is 4:1. Twenty grams of the formulation are applied to the back of a 6-inch (15-cm.) square of tufted polypropylene carpet having a polypropylene scrim. Results similar to those of Example 2 are obtained.

#### EXAMPLE 10

The procedure of Example 9 is repeated with the exception that the following coating composition is employed: 160 parts of a 50 percent solids latex of a polymer of 80 percent ethyl acrylate and 20 percent styrene; 13 parts water; 2 parts of a 10 percent solution of sodium lauryl sulfate; 20 parts of expandable synthetic resinous microspheres having a polymer shell of 80 percent methylmethacrylate and 5.5 percent acrylonitrile Tg  $112^{\circ}\text{C}$ , and containing 35 percent neopentane based on the weight of the polymer shell; and 5 parts of the sodium salt of polyacrylic acid. The latex solid to microsphere ratio is 4:1. The resultant composition is foamed in the manner of Example

10 and commensurate results are obtained.

### EXAMPLE 11

5 The procedure of Example 1 is repeated employing the following coating composition: 160 parts of a 50 percent solids latex of a polymer of 67 percent butyl acrylate and 33 percent acrylonitrile Tg  $-40^{\circ}\text{C}$ ; 13 parts water; 2 parts of a 10 percent solution of sodium lauryl sulfate; 20 parts of expandable synthetic resinous microspheres having a polymer shell of one part methyl methacrylate and one part methyl acrylate and containing 31.5 percent neopentane based on the weight of the polymer shell; and 5 parts of the polyacrylic acid solution of Example 1; the weight ratio of latex solids to microspheres is 80:20. Commensurate results are obtained.

### WHAT WE CLAIM IS:—

1. A carpet comprising a supporting scrim having extending from one side thereof a pile composed of a plurality of filaments, a resilient backing adhered to the scrim remote from said extending filaments, the resilient backing comprising a plurality of synthetic resinous hollow gas-filled microspheres, the hollow microspheres having a polymer shell, the polymer shell having a glass transition temperature of at least  $50^{\circ}\text{C}$ , the microspheres being contained in a synthetic resinous thermoplastic matrix having a glass transition temperature of from  $-50^{\circ}\text{C}$  to  $+20^{\circ}\text{C}$ .
2. A carpet as claimed in claim 1 wherein the synthetic resinous thermoplastic matrix has a glass transition temperature of from  $-7^{\circ}\text{C}$  to  $+20^{\circ}\text{C}$ .
3. A carpet as claimed in claim 1 or claim 2 wherein the microspheres have a bulk density of 0.25 to 5 pounds per cubic foot (4—80 kg./m.<sup>3</sup>).
4. A carpet as claimed in any one of the preceding claims wherein the polymer shell of the hollow microsphere is a copolymer of styrene and acrylonitrile.
5. A carpet as claimed in claim 4 wherein the polymer shell of the hollow microsphere is a copolymer of 60 parts by weight styrene and 40 parts by weight acrylonitrile.
6. A carpet as claimed in any one of

claims 1 to 5 wherein the matrix is a copolymer of styrene and butadiene.

7. A carpet substantially as hereinbefore described in any one of the specific Examples.

8. A method for the preparation of a backed carpet which method comprises applying to the back side of a pile carpet a foam forming composition comprising in intimate admixture an aqueous dispersion containing from 15 to 85 parts by weight of a film forming synthetic resinous latex binder having a glass transition temperature of from  $-50$  to  $+20^{\circ}\text{C}$ , and from 85 to 15 parts by weight of expandable synthetic resinous microspheres, the expandable microspheres having a synthetic resinous thermoplastic shell having encapsulated therein a volatile fluid expanding agent, the shell having a glass transition temperature of at least  $50^{\circ}\text{C}$ , heating the dispersion to remove water therefrom and cause the latex to form a matrix about the expandable microspheres, and heating to cause expansion of the microspheres to form a plurality of gas-filled monocellular thermoplastic shells.

9. A method as claimed in claim 8 wherein the film forming synthetic resinous latex binder has a glass transition temperature of from  $-7^{\circ}\text{C}$  to  $+20^{\circ}\text{C}$ .

10. A method as claimed in claim 8 or claim 9 wherein the latex binder is a copolymer of styrene and butadiene.

11. A method as claimed in any one of claims 8 to 10 wherein the expandable microspheres have a shell of a styrene-acrylonitrile copolymer.

12. A method as claimed in any one of claims 8 to 11, wherein the aqueous dispersion has a viscosity of from 5000 to 10000 centipoise.

13. A method for the preparation of a backed carpet substantially as described hereinbefore in any one of the specific Examples.

14. A backed carpet whenever prepared by a method as claimed in any one of claims 8 to 13.

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